A New Subgenus and Fifteen New Species of *Echeandia* (Anthericaceae) from Mexico and the United States

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ABSTRACT. Two subgenera in *Echeandia* (Anthericaceae), i.e., subg. *Echeandia* and subg. *Mscavea*, are recognized based on time of flower opening, tepal shape, flower color, and habitat differences. Fifteen species are proposed. One, *E. texensis*, is based on four collections made near Brownsville, Texas, and is surely rare, possibly extirpated. The recognition of five species clarifies the distributional range of *E. reflexa*, a common species of eastern Mexico. Seven species are endemic to Guerrero and adjacent areas of Michoacán, México, Morelos, and/or Oaxaca. A key to the species of subgenus *Mscavea* and white-flowered species of subgenus *Echeandia* is provided.

Echeandia, as described by Ortega (1800: 135, tab. 18), included New World species with connate anthers and scaled filaments. These traits effectively separated *Echeandia* and Old World *Anthericum*, which had free anthers and smooth or papillate filaments. With few exceptions, New World species with free anthers were included in *Anthericum* for the next 180 years. However, during that time, species with smooth filaments were included in *Echeandia* (see Weatherby, 1910), and species with scaled filaments were described in *Anthericum* (Baker, 1876; Greenman, 1898). Thus, for the past century or more, New World *Anthericum* and *Echeandia* were separated simply on the nature of their anthers, and the unique traits they shared were ignored. Because most New World species described in *Anthericum* and *Echeandia* share traits that are unique in Anthericaceae, including a corm and scaled filaments, they are now included in *Echeandia* (see Cruden, 1987, 1994), which, with 78 described species, is the second largest genus in Anthericaceae (see Chase et al., 1996; Dahlgren et al., 1985: 186). Excluded from *Echeandia* are approximately 20 white-flowered South American species with smooth filaments and free anthers that probably constitute an undescribed genus.

Within *Echeandia* there are two distinct lineages, and each includes species with free anthers and others with connate anthers. The two lineages share at least two synapomorphies. First, all *Echeandia* have a corm that produces new storage roots and inflorescences yearly. Other Anthericaceae are rhizomatous, and only the terminal segment produces leaves and inflorescences. There is no evidence that a segment produces inflorescences in successive years. Second, most genera in Anthericaceae s. str. have smooth and/or papillate filaments, e.g., *Chlorophytum* s.l. (Kativu & Nordal, 1993) and *Hagenbachia* (Cruden, 1987), whereas most *Echeandia* (63/78) have scaled filaments and those with smooth filaments occur in derived groups.

In addition, anthers adapted for pollination by vibratory bees occur in both lineages and are unique in Anthericaceae s. str. In the white-flowered lineage the anthers in 21 of 25 species are connate and form a cone, and in the other 4 species the individual anthers are adapted for buzz pollination (see below). In the yellow-flowered lineage, 19 of 53 species have anther cones and in 4 additional species the individual anthers are adapted for buzz pollination. The filaments of all these species are inserted dorsally within a basipetally opening pocket, which effectively holds the anther on the same axis as the filament and probably provides the structural stability needed to support a bee while it vibrates an anther or anther cone. It is possible that connate anthers constitute a parallel apomorphy. In other *Echeandia* and most other Anthericaceae, the anthers are free, usually versatile, dorsifixed, and dehisce laterally. In most *Chlorophytum*, however, the filaments are inserted more or less basally in a deep pit, which restricts the movement of the anthers.

Finally, relative to *Echeandia*'s putative ancestor, both lineages combine a mixture of primitive and derived traits. Based on other Anthericaceae, that ancestor had white flowers, which probably opened relatively early in the morning, broadly elliptical tepals, smooth filaments, and versatile anthers that dehisced laterally. Thus, yellow flowers are apomorphic in one lineage, as are narrowly elliptical inner tepals and late opening flowers in the other.

Thus, the available data are consistent with a common ancestor diverging into two lineages, which are formally recognized below as subgenera.

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The two lineages share several synapomorphies and are separated by a number of apomorphies. Further, the two lineages tend to occur in different climatic zones (see below). I include the two lineages in *Echeandia* as subgenera because the differences that separate them do not appear to be as great as those separating other genera in Anthericaceae. However, a more detailed examination of the relationships among genera in Anthericaceae using other techniques might lead to a different conclusion.

Subgenus *Mscavea* is proposed to include species in the white-flowered lineage, whose flowers open late in the morning or in the afternoon, and have narrow inner tepals. This subgenus honors Marion S. Cave, eminent embryologist and student of the Liliaceae s. lat., who stimulated my interest in Mexican Liliaceae in general and *Echeandia* in particular.

Echeandia subg. **Mscavea** Cruden, subg. nov. TYPE: *Echeandia mcvaughii* Cruden, Contr. Univ. Michigan Herb. 16: 129. 1987. [Illustrated in McVaugh, 1989: 187.]

Ab *Echeandia* subg. *Echeandia* tepalis interioribus anguste ellipticis albis vel cremis raro flavis, floribus aperientibus ante vel post meridiem differt.

The two subgenera differ in time of flower opening, tepal shape, width, and color, capsule shape, and altitudinal distribution. The flowers of species in *Echeandia* subg. *Echeandia* open shortly before or after sunup. All but 1 of 53 species have broadly elliptical inner tepals. In the 40 species for which I have reasonable data, the minimum width of the inner tepal in 27 species was 4.5 mm, and the median width exceeded 4.5 mm in 36 species. Most of the species (44/53) are yellow-flowered, and six include white-flowered populations. Nine species are white-flowered. In contrast, in subgenus *Mscavea*, the flowers open late in the morning or the afternoon, 24 of 25 species have narrowly elliptical inner tepals, and, in 22 of 23 species for which I have reasonable data, the maximum width of the inner tepal was 4.5 mm. Most of the species have white flowers (22/25), two have cream-colored flowers, one has orange flowers, and one, possibly two, species include orange- or yellow-flowered populations.

Capsule shape differs significantly between the two subgenera ($\chi^2 = 13.91$, $p \gg 0.001$; analysis with a contingency table and Chi-square test). For those species in subgenus *Echeandia* for which there are data, 26 have oblong capsules (length at least twice the width) and 16 have subglobose to broadly oblong capsules, whereas just 2 species in subgenus *Mscavea* have oblong capsules, and 17 have subglobose to broadly oblong capsules.

Table 1. Distribution of species in subgenus *Echeandia* and subgenus *Mscavea* as a function of elevation. A species was assigned to a given category if most of its elevational range was included in that category. The range of two species in *Echeandia* extended from slightly below 800 m to 2400 m. They were counted as being half in one category and half in the other category.

	Below 800 m	800–1500 m	1500–2400 m	above 2400 m
Subg. *Echeandia*	6	8	30	9
Subg. *Mscavea*	8	12	5	0

Relative to species in subgenus *Mscavea*, those in subgenus *Echeandia* tend to occur at higher elevations (Table 1; $\chi^2 = 19.84$, $p \ll 0.001$). Most species in subgenus *Echeandia* (>70%) occur completely or primarily above 1500 m, and nine occur above 2400 m, whereas 80% of the species in subgenus *Mscavea* occur completely or primarily below 1500 m, and only four reach 2400 m. It is not obvious that a disproportionate number of species in subgenus *Mscavea* relative to subgenus *Echeandia* occur below 800 m ($\chi^2 = 4.93$, $p < 0.05$). In essence, most species in subgenus *Mscavea* occur in drier habitats with subtropical to warm-temperate climates, whereas most species in subgenus *Echeandia* occur in relatively mesic habitats with warm- to cold-temperate climates.

The occurrence of connate anthers is not equivalent in the two subgenera. Only 19 of 53 species in subgenus *Echeandia* have connate anthers, compared to 21 of 25 species in subgenus *Mscavea*. Because most species in subgenus *Mscavea* have connate anthers, one might anticipate that species with connate anthers occur at lower elevations. However, there is no relationship between occurrence of connate anthers and elevation in either subgenus *Echeandia* ($\chi^2 = 1.18$, $p > 0.5$) or subgenus *Mscavea* ($\chi^2 = 0.09$, $p > 0.975$).

Among those species with connate anthers, the two subgenera differ with respect to the insertion of the filaments, which is either dorsal and hidden within a pocket or between the anther sacs and essentially basal. In most species of subgenus *Mscavea* (12/20 examined), the distance from the lower edge of the pocket to the base of the anther is shorter than in 18 of 19 species in subgenus *Echeandia* examined (0.1–0.6 mm vs. 0.6–2.0 mm; $\chi^2 = 13.137$, $p \ll 0.001$). There is no correlation between anther length and distance from the lower

edge of the pocket to the base of the anther in either subgenus *Echeandia* ($r = 0.289$, $n = 19$, $p \gg 0.05$) or subgenus *Mscavea* ($r = 0.237$, $n = 20$, $p \gg 0.05$). Finally, in six species of subgenus *Mscavea* but just one of subgenus *Echeandia*, insertion of the filaments is basal or essentially so.

Among species with free anthers, the anthers of all four species in subgenus *Mscavea* dehisce apically compared to 4 of 33 species in subgenus *Echeandia*. In three species of subgenus *Mscavea*, the line of dehiscence is fused ⅓–⅔ the length of the anther, and dehiscence is through a relatively large teardrop-shaped opening. In one species of subgenus *Mscavea* and the four species of subgenus *Echeandia*, the line of dehiscence is completely open, and dehiscence is through a much smaller apical opening.

Key to Mexican Subgenus *Mscavea* and White-flowered Subgenus *Echeandia*

In any couplet, a clause preceded by "if" takes precedence over other clauses. Leaf shape follows that proposed by the Systematics Association Committee (1962). The names of species described in this paper are not followed by the author's name. The subgenus of each species is given: (E) = subg. *Echeandia*, (M) = subg. *Mscavea*. See also keys in McVaugh (1989) and Cruden (1994).

1. Anthers free 2
1. Anthers connate, forming a cone 3
2(1). Filaments smooth 4
2. Filaments scaled 7
3(1). Filaments smooth 20
3. Filaments scaled 26

Anthers Free, Filaments Smooth

4(2). Scapes with scattered enations or glabrous . . 5
4. Scapes hirsute or scabrous, at least in lower half, frequently throughout 6
5(4). Anthers not versatile, line of dehiscence partially fused, bases flared; tepals narrowly elliptic, 6–8 mm long (below 1200 m, Jalisco) . . . . . *E. pihuamensis* Cruden (M)
5. Anthers versatile, dehiscence lateral, bases straight; tepals broadly elliptic, 8–13 mm long (above 1600 m, Durango and San Luis Potosí to México) . . . . . *E. durangensis* (Greenman) Cruden (E)
6(4). Basal leaves narrowly linear, veins papillate below, margins ciliate, if tips strongly recurved (1800–1900 m, Oaxaca, Puebla) . . . . . *E. parva* Cruden (E)
6. Basal leaves narrowly ovate to narrowly elliptic, flat, veins smooth below, margins entire or nearly so, tips straight (mostly above 2000 m, San Luis Potosí to Veracruz and Puebla W to Michoacán) . . . . . *E. nana* (Baker) Cruden (E)

Anthers Free, Filaments Scaled

7(2). Eastern Mexico (Tamaulipas, San Luis Potosí, Veracruz, Tabasco, Campeche) below 500 m 8
7. Elsewhere in Mexico and/or at higher elevations 9
8(7). Flowers white (Tamaulipas) . . . . . *E. tamaulipensis* (E)
8. Flowers yellow-orange (Campeche) . . . . . *E. campechiana* Cruden (M)
9(7). Basal leaves 2–6 mm wide, 5–15 cm long, margin long ciliate, veins on lower surface papillate and/or bearing long hairs; storage roots 4–10 cm from the corm (Oaxaca) . . . . . *E. confertiflora* Cruden (E)
9. If most basal leaves wider or longer, margin entire to ciliate, and/or the veins smooth below; if storage roots enlarged 1–2 cm from the corm 10
10(9). Anthers dehisce apically; anther walls not reflexed but may be open along line of dehiscence and the wall flared at apex; most more than 3 mm long 11
10. Anthers dehisce laterally; anther walls reflexed, if anthers twisted or obviously versatile; most less than 3 mm long (sometimes longer in *E. gentryi* (M) and *E. durangensis* (E)) 14
11(10). Cauline leaves 7–11, becoming white when dry; storage roots close to the corm; basal leaves more than 20 mm wide (Jalisco) . . . . . *E. robusta* Cruden (M)
11. Cauline leaves 1–6, if more, then storage roots 4–10 cm from the corm; if basal leaves less than 20 mm wide 12
12(11). Tepals 7–8 mm long; line of dehiscence partially fused (Oaxaca, Puebla) . . . . . *E. mirandae* Cruden (M)
12. Tepals 11–21 mm long; line of dehiscence completely open 13
13(12). Ovaries 3–4 mm long (Puebla) . . . . . *E. michoacensis* (Poellnitz) Cruden (E)
13. Ovaries 2–3 mm long (Chiapas) . . . . . *E. matudae* Cruden (E)
14(10). Scapes pubescent, sometimes weakly so or only near the base 15
14. Scapes glabrous 16
15(14). Storage roots enlarged 1–4 cm from corm; margins of basal leaves ciliate to long ciliate; scape scabrescent, at least toward the base (Chihuahua and Nayarit SE to Michoacán) . . . . . *E. scabrella* (Bentham) Cruden (E)
15. Storage roots enlarged 3–8 cm from corm; margins of basal leaves denticulate; shoot with minute scattered hairs in lower half (Oaxaca) . . . . . *E.* sp. (E)
16(14). Filaments 9–15 mm long; most basal leaves 1–6 mm wide; if style scaled (Guerrero, México, Morelos) . . . . . *E. tenuis* (Weatherby) Cruden (E)
16. Filaments less than 8 mm long; or if most basal leaves more than 6 mm wide 17
17(16). Basal leaves 1–7 mm wide, narrowly linear to linear, margins denticulate; most storage roots enlarged 3–8 cm from corm; capsules subglobose to broadly oblong (length < twice the width) (Oaxaca, Puebla) . . . . . *E. graminea* Martins & Galeotti (E)

17. If most basal leaves 7 or more mm wide; storage roots enlarged 1–3 cm from corm; if capsules oblong (length at least twice the width) 18
18(17). Basal leaves 1–6 mm wide, narrowly linear; filaments inserted in a pocket, not versatile; ovaries 1.8–2.5 mm long (Jalisco, Nayarit, Sinaloa, Durango) . . . . . *E. gentryi* Cruden (E)
18. If most basal leaves 7 mm or more wide; ovaries 2.5–4 mm long 19
19(18). Leaves broadly linear to narrowly ovate; anthers versatile (above 1600 m, mts. of Durango and San Luis Potosí S to México and Hidalgo) . . *E. durangensis* (Greenman) Cruden (E)
19. Leaves linear, frequently falcate; anthers not versatile due to reflexed anther walls. (Guanajuato) . . . . . *E. sanmiguelensis* (E)

Anthers Connate, Filaments Smooth

20(3). Basal leaves abruptly expanded near the middle into a broad blade, appearing petiolate (Guerrero) . . . . . *E. pseudopetiolata* (M)
20. Width of basal leaves not changing abruptly 21
21(20). Scapes scabrous beyond first cauline leaf and/or if basal margins of leaves ciliate to long ciliate 22
21. Scapes glabrous or rarely scabrescent near the base 25
22(21). Scapes usually more than 1 m high, cauline leaves 6–15; basal leaves 15–40 mm wide (rarely narrower), margin entire to short ciliate; tepals 9–13 mm long (Guerrero, Morelos) . . . . . *E. mexiae* (M)
22. Scapes rarely 1 m high; if cauline leaves 0–4, if most basal leaves less than 10 mm wide, their margins ciliate to long ciliate, and/or tepals less than 9 mm long 23
23(22). Basal leaves 2–11 mm wide, most less than 10 mm wide, flat, margin entire to denticulate; tepals 8.5–10.5 mm long; anthers (1.8–)2–3 times the length of the filaments; scapes 15–40 cm high (below 500 m, Jalisco, Sinaloa) . . . . . *E. sinaloensis* Cruden (M)
23. If most of the basal leaves more than 10 mm wide, falcate, their tips strongly recurved, or the margin ciliate to long ciliate; if tepals less than 8 mm long; anthers 1–1.6(–2) times the length of the filaments; if scape more than 50 cm high 24
24(23). Basal leaves 6–12 mm wide, very narrowly linear to very narrowly elliptic, frequently falcate and/or with strongly recurved tips, frequently undulate, margins densely ciliate to long ciliate (rarely denticulate or short ciliate) (Jalisco, Colima SE to Oaxaca, Chiapas, and Guerrero to Veracruz) . . . *E. parviflora* Baker (M)
24. Basal leaves (8–)13–28 mm wide, flat, narrowly ovate to narrowly elliptical, margins entire to minutely denticulate (below 800 m, Guerrero, México) . . . . . *E. atoyacana* (M)
25(21). Capsules globose, 2.5–4 mm long; basal leaves 4–8, 6–15 mm wide; cauline leaves 2–6 (Jalisco, Nayarit) . . . . . *E. parvicapsulata* Cruden (M)
25. Capsules broadly oblong, 6–10 mm long; basal leaves 7–13, if most more than 15 mm wide; cauline leaves (4–)5–10 (Sonora, Chihuahua, to Guerrero) . . . . . *E. ramosissima* (Presl) Cruden (M)

Anthers Connate, Filaments Scaled

26(3). Eastern Mexico (Tamaulipas, San Luis Potosí, Veracruz, Campeche, Yucatán) below 1600 m; if flowers cream-colored 27
26. Elsewhere in Mexico or above 1800 m . . . 29
27(26). Flowers cream-colored (Campeche, Quitana Roo, Yucatán, Oaxaca) . . . . . *E. luteola* Cruden (M)
27. Flowers white 28
28(27). Anthers 7–9 mm long, twice the length of the filaments; leaf margins ciliate to long ciliate (Tamaulipas, San Luis Potosí) . . . . . *E. macrophylla* Rose (M)
28. Anthers 4–7 mm long, barely longer than the filaments; leaf margins denticulate to ciliate (Veracruz) . . . . . *E. albiflora* (Schlechtendal & Chamisso) Martins & Galeotti (M)
29(26). Apexes of anther cones 1.2–3.5 mm wide; anther cones 2.5–4.0 mm wide and 4–5(–7) mm long; basal leaves 2–7 mm wide, veins on lower surface noticeably papillate (Oaxaca) . . . . . *E. conzattii* Cruden (E)
29. If apexes of anther cones less than 1 mm wide, or anther cones less than 2 mm wide; if basal leaves smooth below and/or most more than 10 mm wide; if storage roots enlarged 1–3 cm from corm 30
30(29). Most basal leaves less than 5 mm wide . . . 31
30. Most basal leaves more than 5 mm wide . . 34
31(30). Storage roots enlarged 3 cm or more from corm; anthers 1–1.5 times the length of the filaments 32
31. Storage roots enlarged 0.5–2.0 cm from corm; if anthers 1.8–2.2 times the length of the anthers 33
32(31). Tepals broadly elliptic, 5–7 mm wide, 11.5–15 mm long; filaments (4–)5–7 mm long (Guerrero, México, Morelos, Oaxaca) . . . . . *E. taxcana* (E)
32. Tepals narrowly elliptic, 1.5–3 mm wide, 7.5–12.5 mm long; filaments 2.5–4 mm long . . . . . *E. parviflora* Baker (M)
33(31). Anthers 1–1.6 times the length of the filaments; capsules 7–11.5 mm long (above 800 m, Nayarit) . . . . . *E. flexuosa* Greenman (E)
33. Anthers 1.8–2.2 times the length of the filaments; capsules 5–7 mm long. (below 500 m, Nayarit, Sinaloa) . . . . . *E. nayaritensis* (M)
34(30). Scapes pubescent, at least toward the base, and sometimes sparsely so 35
34. Scapes glabrous 39
35(34). Leaf margins long ciliate, hairs usually 0.2–0.5 mm long; scapes usually hirsute, hairs long and flat; basal leaves (10–)15–40 mm wide

(Guerrero, México, E Michoacán) . . . . . *E. hirticaulis* (M)

35. Leaf margins entire to ciliate, rarely long ciliate; scapes mostly scabrescent; if most basal leaves 2–8 mm wide 36

36(35). Leaf margins ciliate to long ciliate, sometimes densely so; basal leaves 2–8 mm wide, frequently falcate; anthers 3–7 mm long, most 1.2–1.8 times the length of the filaments; tepals 7.5–12 mm long; basal leaves 1–8 mm wide . . . . . *E. parviflora* Baker (M)

36. Leaf margins entire to short ciliate, rarely ciliate; if most basal leaves more than 10 mm wide; if anthers 7.5–12 mm long and/or 1.8–2.2 times the length of the filaments; if tepals more than 12 mm long 37

37(36). Storage roots enlarged 4–8 cm from corm; if lower leaf surface minutely papillate between the veins; capsules 7–9 mm long (Guerrero) . . . . . *E. hintonii* (M)

37. Storage roots enlarged 1–2 cm from corm; lower leaf surface smooth between the veins; if capsules shorter or longer 38

38(37). Anther cones 6–11 mm long, usually widest in the middle; if anthers 1.8–2.2 times the length of the filaments; capsules 4–7 mm long; basal leaves 5–10, frequently falcate, if most more than 15 mm wide and/or less than 25 cm long (Jalisco, Nayarit) . . . . . *E. mcvaughii* Cruden (M)

38. Anther cones 5.5–7 mm long, 1–1.4 times the length of the filaments, usually widest toward the base; capsules 9–12 mm long; basal leaves 3–5, narrowly elliptic, straight, 6–12 mm wide and more than 30 cm long (Oaxaca) . . . . . *E. oaxacana* Cruden (M)

39(34). Most storage roots enlarged 3–8 cm from corm; anther cones widest toward the base, tapered gradually to the apex, usually 1–1.7 times the length of the filaments 40

39. Most storage roots enlarged 1–3 cm from corm; if anther cones widest in middle and/or 1.8–3 times the length of the filaments 41

40(39). Tepals 9–13 mm long; anther cones 4–8 mm long; cauline leaves 1–5; if underside of basal leaves minutely papillate between veins (Guerrero) . . . . . *E. hintonii* (M)

40. Tepals 13–20 mm long; anther cones 8–12 mm long; cauline leaves 4–10; basal leaves smooth below (Guerrero, Morelos) . . . . . *E. elegans* (M)

41(39). Tepals 9–11 mm long; anther cones 5.5–8 mm long, usually widest near the base and gradually tapered to the apex; basal leaves narrowly linear, 30–45 cm long, 5–14 mm wide, not falcate (Michoacán) . . . . . *E. coalcomanensis* Cruden (M)

41. Tepals 10–19 mm long; anther cones 6–12 mm long, if cones widest in middle; if most basal leaves falcate, less than 20 cm long, and/or more than 15 mm wide 42

42(41). Basal leaves 4–8 mm wide, narrowly linear, straight; ovaries 1–2 mm long (below 600 m, Nayarit, Sinaloa) . . . . . *E. nayaritensis* (M)

42. Basal leaves 10–30 mm wide, most narrowly obovate or narrowly elliptic, frequently falcate; ovaries 2–3 mm long (above 1200 m, Jalisco, Nayarit) . . . . *E. mcvaughii* Cruden (M)

Fifteen species are proposed below: eight in subgenus *Echeandia* and seven in subgenus *Mscavea*.

The species in subgenus *Echeandia* with connate anthers comprise the taxonomically most difficult group in the genus and include *E. reflexa* (Cavanilles) Rose, the type species of the genus. Because this species is quite variable and has a broad geographical range, and given the lack of recent systematic analysis, it is not surprising that specimens with connate anthers from eastern and central Mexico, as well as elsewhere, were included, indiscriminately, in *E. reflexa*. I propose *E. pseudoreflexa* and *E. texensis* to include such material from Chiapas (Cruden, 1994) and Texas (see Johnston, 1990), respectively; *E. palmeri* is proposed to include specimens from Durango and Chihuahua. Only *E. pseudoreflexa* appears to be closely related to *E. reflexa* (see below). The description of two additional species should clarify the distribution of *Echeandia* in eastern and central Mexico. *Echeandia falcata* is proposed to include plants from Querétaro and Guanajuato with relatively short, broad anther cones, and *E. taxcana* is proposed to included narrow-leaved plants with strongly tapered anther cones from Oaxaca, Guerrero, Morelos, and México.

With the recognition of these species, *E. reflexa* is a more coherent, albeit variable, entity found primarily between 200 and 3000 m on the eastern slopes of the Sierra Madre Oriental and adjacent parts of the Sierra Volcánica Transversal from central Nuevo León and southern Tamaulipas to southern Puebla, adjacent Oaxaca, and Veracruz. Populations from low elevations are usually robust, with highly branched inflorescences, and long, broad straight leaves. At mid elevations, the plants are less robust with fewer branches and narrower, shorter leaves; and at high elevations, the leaves are usually narrow and frequently falcate. Specimens from higher elevations in Puebla and adjacent Veracruz and Oaxaca have falcate, undulate basal leaves and resemble small specimens of *E. paniculata* Rose. Flowers of *E. reflexa* have a long (6–9 mm), slender, strongly tapered anther cone, which usually has a small, minutely lobed apex.

Figure 1. Distributional ranges of the eight new species in subgenus *Echeandia* are illustrated.

1. Echeandia pseudoreflexa Cruden, sp. nov. TYPE: Mexico. Chiapas: road to Venustiano Carranza, ca. 3 km SW of Santa Rosalia, hillside with *Convolvulus, Calliandra, Lantana, Dahlia,* 1200 m, 3 Sep. 1971, *Cruden 1936* (holotype, UC; isotypes, MEXU, MO).

Radicibus penariis a cormo 1–3 cm, foliis basalibus anguste linearibus vel anguste ellipticis 7–12 mm latis marginibus denticulatis ad breviciliatis, scapis glabris, tepalis flavis, filamentis squamosis, antheris connatis 5–7.5 mm longis, conis antherarum ad apicem valde contractis.

Storage roots enlarged 1–3 cm from corm. Basal leaves 5–8, narrowly linear to narrowly elliptical, 34–64 cm long, 7–12 mm wide, denticulate to short ciliate. Scapes glabrous, 0.6–1.5 m high, 2–6-branched, major axis with 12–20 flower-bearing nodes. Cauline leaves (0–)2–6, lowest 17–24(–32) cm long, usually exceeding the next node. Flowers yellow, nutant. Tepals 11–16 mm long, inner broadly elliptic 5 mm wide, outer elliptic 2.5 mm wide (one flower examined). Filaments scaled, narrowly clavate, 5–7 mm long, insertion dorsal in a pocket. Anthers connate, 5–7.5 mm long, equal to or slightly longer than the filaments; the cones strongly tapered, apex barely emarginate to shallowly and broadly lobed 0.5–0.8(–1.2) mm wide. Ovaries 2.5–4 mm long. Capsules oblong to narrowly oblong, 9–14.5 mm long, 4.5–5.5 mm wide. In flower August–September, December. Chromosome number $n = 16$ (*Cruden 1936*).

With the exception of material collected near La Ciénega de León, this species is known only from central Chiapas between 1100 and 1800 m (Fig. 1). It occurs in forests dominated by some combination of pine, oak, and *Liquidambar.*

Material of *E. pseudoreflexa* was included in *E. reflexa* in *Flora Mesoamericana* (Cruden, 1994) because of its robust shoots and leaves and strongly tapered anther cone. It is distinguished from most populations of *E. reflexa* by storage roots that are enlarged 1–3 cm from the corm, narrower basal leaves, and the bases of the previous year's leaves forming a fibrous collar. The storage roots of *E. re-*

flexa are usually enlarged 3–6 cm from the corm, and the previous year's leaf bases remain more or less intact. The long, lower cauline leaf distinguishes this species from many specimens of *E. formosa* (Weatherby) Cruden.

Paratypes. MEXICO. **Chiapas**: Ruta 190, 58 km N El Jocote, 7 mi. from La Trinitaria, 1350 m, 19 Sep. 1988, *Stevens & Martinez 25767* (MO); Mpio. Cintalapa, near Oaxaca-Chiapas border, near La Ciénega de León, 1080–1230 m, 1 Dec. 1980, *Breedlove & Almeda 48171* (CAS); Mpio. Pueblo Nuevo Solistahuacán, 3 km NW Pueblo Nuevo Solistahuacán, 5800 ft., 28 Aug. 1970, *Zwill 293* (DS); Mpio. Tenejapa, barrio Tuk, paraje Matsab, 7500 ft., 30 Sep. 1965, *Breedlove 12552* (DS); Mpio. Teopisca, southern limits of Teopisca, 5900 ft., 19 Aug. 1966, *Breedlove 15049* (DS, F).

2. Echeandia texensis Cruden, sp. nov. TYPE: U.S.A. Texas: Green Island, 23–29 June 1922, *Tharp 1129* (holotype, TEX; isotype, US).

Radicibus penariis a cormo 2–4 cm, scapis glabris, foliis basalibus 4–9 linearibus ad ellipticis 10–20 mm latis marginibus denticulatis, tepalis flavis, filamentis squamosis, antheris connatis 4–5.5 mm longis, conis antherarum 2–3 mm latis plerumque filamentis brevioribus.

Storage roots enlarged 2–4 cm from corm. Basal leaves 4–9, 33–60 cm long, 10–20 mm wide, linear to narrowly elliptic, sometimes weakly falcate, minutely denticulate to denticulate. Scapes glabrous, 56–105 cm high, unbranched. Cauline leaves 4–5, (4.3–)10–20 cm long, lowest frequently exceeding the next node. Flowers yellow, nutant. Tepals 12–19 mm long, inner broadly elliptic, 6–8.5 mm wide, outer elliptic, 2.5–3.5 mm wide. Filaments scaled, narrowly clavate, 5–9 mm long, insertion dorsal in a pocket. Anthers connate, 4–5.5 mm long, the cones 2–3 mm wide, usually shorter than the filaments, weakly to strongly tapered, apex 1–1.5 mm wide, deeply and broadly lobed. Ovaries 2–3.5 mm long. Capsules oblong, 9–13 mm long, 4–6 mm wide. In flower June, October–November.

This species is based on four collections made near Brownsville, Texas (Fig. 1), prior to 1952. These suggest a rather limited distributional range, and the lack of recent collections suggests this species is rare and probably endangered, if not already extirpated. The limited data suggest it is a species of clay dunes and llanos.

Specimens of *E. texensis* were included in *E. reflexa* because they have long broad basal leaves, overlapping cauline leaves, and oblong capsules. The short, broad, and deeply lobed anther cones are similar to those of *E. conzattii* Cruden, *E. palmeri* Cruden, *E. flexuosa* Greenman, and *E. falcata* Cruden, all of which have narrower basal leaves, fewer cauline leaves that only occasionally overlap, and anthers that are usually equal to, or longer than, the filaments. *Echeandia texensis* is easily distinguished from *E. reflexa* by the short, usually broad anther cone with a broadly lobed apex.

Paratypes. U.S.A. **Texas:** Cameron County, vicinity Brownsville, 10 m, 25 Oct. 1945, *Runyon 4082* (TEX); Brownsville, *Runyon 4036* (TEX); Loma del Cayo, 29 Nov. 1951, *Johnston & Tharp 38b-1* (TEX).

3. Echeandia palmeri Cruden, sp. nov. TYPE: Mexico. Durango: Santiago Papasquiaro, Apr. & Aug. 1896, *Palmer 410* (holotype, US; isotypes, F, GH, MO, NY).

Radicibus penariis a cormo 2–4 cm, foliis basalibus anguste linearibus 1–7.5 mm latis marginibus denticulatis ad ciliatis, scapis glabris, tepalis flavis, filamentis clavatis squamosis, conis antherarum 3.5–7 mm longis ad apicem infirme contractis.

Storage roots 1.5–3 cm long, enlarged 2–4 cm from corm. Basal leaves 5–9, narrowly linear, (15–)24–40 cm long, (1.5–)3–7.5 mm wide, margins denticulate to ciliate, veins forming the midrib sometimes papillate. Scapes glabrous, (35–)58–74 cm high, bearing 0–2 branches. Cauline leaves 1–2, lowest 3.5–7.6(–13) cm long, rarely reaching next node. Flowers yellow, probably nutant. Tepals 13–19 mm long, inner broadly elliptic, 6–8 mm wide, outer elliptic, 3–4 mm wide. Filaments scaled, narrowly clavate, 4–6 mm long, insertion dorsal in a pocket. Anthers connate, (3.5–)4–7 mm long, the cones widest at base, tapered to apex, 1.5–3.5 mm wide, apex (0.7–)1.1–2.1 mm wide, broadly sometimes coarsely toothed. Ovaries 2.5–5.5 mm long. Capsules oblong, (9–)11–15 mm long, 4.5–6 mm wide. In flower August–September.

The broad, weakly tapered anther cone, narrow leaves, and storage roots enlarged 2 or more cm from the corm are similar to those of *E. conzattii*, *E. flexuosa*, and *E. falcata*. The veins on the underside of the basal leaves of *E. conzattii* are usually papillate, and it has white flowers. In general, *E. flexuosa* and *E. falcata* have more cauline and basal leaves than *E. palmeri*; the basal leaves of many *E. flexuosa* plants are narrower and those of *E. falcata* are falcate.

The specific epithet honors Edward Palmer, noted collector of Mexican plants.

Paratypes. MEXICO. **Chihuahua:** hills near Chihuahua, 6 Sep. 1886, *Pringle 1109* (MEXU, MO, NY). **Sonora:** Yécora, 3 Sep. 1970, *Pennington 103* (TEX); old road to Maycoba, 0.5 mi. E Arroyo Yécora, 1550 m, 7 Sep. 1995, *Fishbein 2478* (MO).

4. Echeandia falcata Cruden, sp. nov. TYPE: Mexico. Guanajuato: Ruta 49, near Km 32, ca. 7 km N San Miguel de Allende, grassy hillside with *Opuntia*, *Ipomoea*, 1880 m, 4 Aug. 1968, *Cruden 1459* (holotype, UC; isotypes, ENCB, F, GH, K, MEXU, MO, NY, US).

Radicibus penariis a cormo 3–5 cm, foliis basalibus 2–12(–14) mm latis linearibus ad anguste ovatis plerumque falcatis marginibus ciliatis, scapis glabris vel ad basim infirme pubescentibus, tepalis flavis, filamentis clavatis squamosis, antheris connatis 4–6.5 mm latis, conis antherarum ad apicem infirme contractis.

Storage roots enlarged 3–5 cm from the corm, usually long-tapered. Basal leaves (5–)7–11(–14), linear to narrowly ovate, weakly to strongly falcate, occasionally straight, 10–52 cm long, 2–12(–14) mm wide, margin short ciliate; veins on lower surface smooth, rarely papillate. Scapes glabrous or weakly scabrous, 15–85 cm high, bearing 0–1(–2) branches. Cauline leaves 2–4, the lowest 1–7.5(–10) cm long. Flowers yellow, nutant. Tepals 13–17 mm long, inner broadly elliptic, 6–8.5 mm wide, outer elliptic, 2.5–5 mm wide. Filaments scaled, clavate to narrowly clavate, 4–6 mm long, insertion dorsal in a pocket. Anthers connate, 4–6.5 mm long, the cones weakly tapered, (1.5–)1.8–2.5 mm wide, (0.8–)1–2(–2.8) mm wide at apex. Ovaries 2.5–4 mm long. Capsules broadly oblong to oblong, (5–)10–13(–16) mm long, 5.5–6.5 mm wide. In flower (late June–)August–September. Chromosome number $n = 16$ (*Cruden 1456, 1459, 1803*).

This tetraploid relative of *E. flexuosa* is endemic to Guanajuato and Querétaro (Fig. 1). Two specimens from Guanajuato have long, non-falcate leaves, but the rest have shorter, usually narrow and strongly falcate leaves. The large flowers with weakly tapered, usually broad anther cones are similar to those of *E. flexuosa* from western Michoacán and eastern Jalisco, and distinguish this species from both *E. reflexa* and *E. mexicana* Cruden of adjacent Hidalgo. The falcate leaves, clavate filaments, and somewhat larger capsules distinguish *E. falcata* from *E. flexuosa*.

Paratypes. MEXICO. **Guanajuato:** Guanajuato, 1880, *Duges s.n.* (GH); Ruta 51, between San Miguel de Allende and Comonfort, 2100 m, 5 July 1971, *Genelle & Fleming 898* (DUKE, MO); 18 km S San Miguel de Allende, 1790 m, 4 Aug. 1968, *Cruden 1456* (ENCB, F, K, MEXU, MICH, NY, UC, WIS); ca. 8 km N San Miguel de Allende, 1880 m, 23 Aug. 1970, *Cruden 1806* (GH, UC). **Querétaro:** E San Miguel de Allende, 15 km E Guanajuato-Querétaro state line, 2125 m, 23 Aug. 1970, *Cruden 1803* (UC); Hacienda Ciervo, between San Juan del Río and Cadereyta, 20 Aug. 1905, *Rose, Painter & Rose 9647* (US); Del Ciervo, 20 Aug. 1905, *Altamirano 1597* (US); road toward Tequisquiapan, 21 Aug. 1903, *Rose, Painter & Rose 9703* (US); Tequisquiapan, 18 Sep. 1957, *Paray 2500* (ENCB); near San Juan del Río, 28 Aug. 1905, *Rose, Painter & Rose 9554* (NY, US); 15 km from Higuerillas toward Bernal, 20°54′N, 99°54′W, 2100 m, 25 June 1972, *Wendt, Chiang & Johnston 8100* (TEX).

5. Echeandia taxacana Cruden, sp. nov. TYPE: Mexico. México: Ruta 55, 6.5 km NW Guerrero State Line, 1485 m, 1 Aug. 1970, *Cruden 1721* (holotype, UC; isotypes, F, GH, K, MEXU, MO, US).

Radicibus penariis 1 cm longis a cormo 1.5–5.5 cm, foliis basalibus peranguste linearibus 1–4 mm latis marginibus denticulatis ad ciliatis, scapis glabris vel ad basim scabridis, tepalis flavis vel albis, filamentis clavatis squamosis, antheris connatis 5–7.5 mm longis, conis antherarum ad apicem valde contractis.

Storage roots enlarged 1.5–5.5 cm from corm, ca. 1 cm long. Basal leaves 5–14, very narrowly linear, (10–)15–55 cm long, 1–3(–4) mm wide, margin denticulate to ciliate. Scape glabrous or scabrescent toward the base, 35–85 cm high, bearing 0–1 branches. Cauline leaves 1–3(–5), lowest 1.6–5.5 cm long. Flowers yellow or white, nutant. Tepals 11.5–15 mm long, inner broadly elliptic, 5–7 mm wide, outer narrowly elliptic, 2–3 mm wide. Filaments scaled, clavate, (4–)5–7 mm long, insertion dorsal in a pocket. Anthers connate, (5–)6–7.5 mm long, the cones usually longer than the filaments, strongly tapered, (1.7–)2–2.5 mm wide, apex shallowly lobed, 0.5–0.9 mm wide. Ovaries 2–4 mm long. Capsules broadly oblong, 7.5–9 mm long, 4–4.5 mm wide. In flower July–October. Chromosome number $n = 8$ (*Cruden 1721, 1953*).

The yellow-flowered populations are found in a variety of habitats, including thorn scrub, oak woodlands, and pine-oak woods in Oaxaca, Guerrero, Morelos, and México between 1400 and 2400 m (Fig. 1). The white-flowered plants are essentially like the yellow-flowered ones, but may be from more mesic habitats. The sampled populations are southeast of the distributional range of the yellow-flowered populations between 2000 and 2600 m.

The numerous narrow leaves, slender inflorescences, and broadly oblong capsules are reminiscent of *E. flexuosa*, from which it is distinguished by the strongly tapered anther cone and small storage roots that usually develop some distance from the corm. The narrow leaves distinguish this species from *E. reflexa*, and it usually has more basal leaves than *E. smithii* Cruden.

The specific epithet honors the city of Taxco de Alcarón, which sits at the northwestern end of distributional range of this species.

Paratypes. MEXICO. **Guerrero:** Taxco Road, 18 July 1938, *Kenoyer A519* (F); 19 mi. from Taxco de Alarcón, 3800 ft., 3 July 1941, *Chute M-108* (MICH). **Morelos:** 1905, *Rose, Painter & Rose 8609* (US). **Oaxaca:** Ruta 190, Km 56, ca. 16 km ESE Tamazulapan, 2350 m, 15 Aug. 1970, *Cruden 1773* (UC), 7 Sep. 1971, *Cruden 1953* (ENCB, K, MEXU, NY, TEX, UC, WIS); Ruta 190, Km 406–407, 26.5 km SE Huajuapan de León, 2270 m, 30 July 1968, *Cruden 1444* (UC).

White-flowered specimens examined. MEXICO. **Oaxaca:** Mpio. San Juan Mixtepec, 16 km S San Juan Mixtepec, Monte de Tesoro, 17°14′N, 97°51′W, 2600 m, 6 Oct. 1988, *Santiago 880* (MEXU); 6.7 km W of Miahuatlán on road to Piedra Larga (Coatlánes), 25 Oct. 1982, *Torres, Martinez & Villasenor 1716* (MEXU); Tlaxiaco, San Pedro Molinos, Km 64 on carretera Tlaxiaco–Putla, 17°14′34″N, 97°43′10″W, 2000 m, 3 Aug. 1994, *Panero & Calzada 4439* (TEX).

6. Echeandia attenuata Cruden, sp. nov. TYPE: Mexico. Sinaloa: Ruta 40, Km 204, ca. 5 km W El Palmito, seepage area with *Begonia, Bidens, Dahlia, Castilleja, Cosmos*, 2000 m, 18 Sep. 1971, *Cruden 1997* (holotype, UC; isotypes, ENCB, F, GH, K, MEXU, MO).

Radicibus penariis a cormo 1–2 cm, 3–4 cm longis, foliis basalibus anguste linearibus attenuatis 1–5(–7) mm latis, scapis glabris vel ad basim scabris 30–90 cm altis, foliis caulibus 2–6 longiattenuatis, tepalis flavis ellipticis valde reflexis, filamentis squamosis unumquidque in marsupio insertis 4–6.5 mm longis, antheris libris non versatilis dehiscens lateralibus.

Storage roots enlarged 1–2 cm from the corm, 3–4 cm long. Basal leaves narrowly linear, attenuate, 23–53 cm long, 1–5(–7) mm wide, margin denticulate to serrulate. Scapes glabrous or scabrescent toward the base, 30–90 cm high, bearing 0–4 branches. Cauline leaves (2–)3–5(–6), long attenuate, lower to 17.5 cm long. Flowers yellow, cernuous-declinate. Tepals strongly reflexed, (6.5–)8–13 mm long, inner elliptic, 3.5–5 mm wide, outer narrowly elliptic, 2–2.5 mm wide. Filaments scaled, linear, 4–6.5 mm long, insertion dorsal in a pocket. Anthers free, 2.5–3.25 mm long, not versatile, dehiscence lateral. Ovaries 1.5–3 mm long. Capsule (only one seen) 6.5 mm long, 5 mm wide. In flower late August–September. Chromosome number $n = 8$ (*Cruden 1827*).

Echeandia attenuata is known only from seepage areas between 2000 and 2200 m along the Durango-Sinaloa border (Fig. 1). It is distinguished by the long-attenuate leaves, both basal and cauline, smallish, cernuous-declinate flowers with relatively narrow and strongly reflexed tepals, and filaments that are inserted in a pocket, which forces the anthers to extend along the same axis as the filaments. The narrow, strongly reflexed tepals and nonversatile anthers distinguish it from *E. flavescens* (Schultes & Schultes f.) Cruden, a common species of desert grasslands and conifer forests of interior central and northern Mexico.

Paratypes. MEXICO. **Durango:** 2 mi. NE El Paraíso, Sinaloa on road between Villa Unión and El Salto, 7000 ft., 28 Sep. 1953, *Ownbey & Ownbey 1931* (MICH). **Sinaloa:** Ruta 40, K 204, 5 km W El Palmito, 2000 m, 27 Aug. 1970, *Cruden 1827* (NY, US).

7. Echeandia sanmiguelensis Cruden, sp. nov. TYPE: Mexico. Guanajuato: Ruta 49, Km 30–31, ca. 9 km N of San Miguel de Allende, grazed field along road with *Acacia, Opuntia, Agave*, 1950 m, 4 Aug. 1968, *Cruden 1460* (holotype, UC; isotypes, K, MEXU, MO).

Radicibus penariis a cormo 2–3 cm, scapis glabris 45–75 cm altis, foliis basalibus anguste ovatis falcatis 7–13 mm latis, tepalis albis, filamentis squamosis 5–6 mm longis, antheris libris non versatilis.

Storage roots enlarged 2–3 cm from corm, 3–5 cm long. Basal leaves linear, attenuate, falcate, 5–8, 17–33 cm long, 7–13 mm wide, margin ciliate. Scapes glabrous, 45–75 cm high, bearing 0–2(–4) branches. Cauline leaves 0–2, when present, lower aristate, 18–67 mm long. Flowers white, cernuous-declinate. Tepals 11–15 mm long, inner broadly elliptic, 5.5–7 mm wide, outer elliptic, 3–4.5 mm wide. Filaments scaled, linear, 5–6 mm long, insertion dorsal in a pit. Anthers free, 1.5–2.5 mm long, not versatile due to the reflexed anther walls, dehiscence lateral. Ovaries 2.5–3.5 mm long. Styles bent upward below the stigma. Capsules oblong, (8.5–)10–16 mm long, 3.5–6.5 mm wide. In flower late July–August.

This species is known from only three collections possibly representing just one or two populations near San Miguel de Allende (Fig. 1). The two Cruden collections may be from a single large population.

The falcate leaves, white, declinate flowers, and storage roots enlarged close to the corm suggest a relationship with *E. scabrella* (Bentham) Cruden, which has smaller flowers, subglobose capsules, and scabrescent scapes. The few aristate cauline leaves, if present, broader lanceolate leaves, and longer capsules differentiate it from *E. tamaulipensis* Cruden. The white flowers distinguish this species from *E. flavescens*, which occurs in similar habitats. In addition, few individuals of the latter species have storage roots enlarged close to the corm in combination with 5–8 basal leaves that tend to be falcate.

Paratypes. MEXICO. **Guanajuato:** Ruta 49, Km 31–32, ca. 8 km N of San Miguel de Allende, 1950 m, 23 Aug. 1970, *Cruden 1805* (ENCB, F, GH, MICH, NY, UC, US); San Miguel de Allende, 6500 ft., 26 July 1950, *Spivey 177* (UC).

8. Echeandia tamaulipensis Cruden, sp. nov. TYPE: Mexico. Tamaulipas: Papolote de la Mirandena, 3 mi. SSW of headquarters, Loreto Ranch, 24°20′N, 98°W, 16 Sep. 1960, *Johnston & Crutchfield 5550* (holotype, MEXU; isotypes, LL, MICH, TEX, UC).

Radicibus penariis a cormo (1–)3–6 cm clavatis, foliis basalibus linearibus 4–12 mm latis, scapis glabris vel scabris, tepalis albis, filamentis pauci squamosis 4.5–6.5 mm longis, antheris libris non versatilis dehiscens lateralibus.

Storage roots enlarged (1–)3–6 cm from corm, long tapered, 3–9 cm long. Basal leaves 3–7, linear, 20–65 cm long, denticulate to short ciliate, 4–12 mm wide. Scape glabrous or scabrescent, 40–60 cm high, bearing 0–2(–3) branches. Cauline leaves 1–4, reduced to bracts. Flowers white, probably cernuous-declinate. Tepals 10–15 mm long, inner broadly elliptic, 4.5–5 mm wide, outer narrowly elliptic to elliptic, 1.5–3.5 mm wide. Filaments weakly scaled, linear, 4.5–6.5 mm long, insertion usually dorsal in a deep pit or pocket, if in a shallow pocket, the reflexed anther walls hold the anther on same radius as the filaments. Anthers free, 1.7–2.5 mm long, not versatile, dehiscence lateral. Ovaries 2.5–3.5 mm long. Capsules broadly oblong to oblong, 8–11 mm long, 5–5.5 mm wide. In flower September–October.

This white-flowered species is known only from the coastal plain of central and southern Tamaulipas (Fig. 1). It might be confused with either *E. flavescens* or *E. chandleri* (Greenman & Thompson) M. C. Johnston, which both have yellow flowers. The former occurs at much higher elevations and has versatile anthers, while the latter has somewhat larger flowers and strongly scaled filaments. The Mexican collections of *E. chandleri* are from higher elevations (900–1000 m) or from northern Tamaulipas.

Paratypes. MEXICO. **Tamaulipas:** S Lomas del Real, 7 mi. N of Altamira, 27 Oct. 1959, *Johnston & Graham 4540* (MICH, TEX); Sierra de Tamaulipas, ca. 40 km NNW Aldama, ca. 23°14′N, 98°10′W, above Juan Tomás, E Las Yucas, 13 Oct. 1957, *Dressler 2384* (GH, MO); 15 mi. from Tampico on the Mante highway, 27 Sep. 1959, *Graham & Johnston 4087* (MEXU, MICH, TEX).

The following species are included in subgenus *Mscavea.*

9. Echeandia atoyacana Cruden, sp. nov. TYPE: Mexico. Guerrero: rocky outcrop with *Matalea, Commelina, Cnidosculus,* Ruta 95, Km 103–104, ca. 31 Km S bridge over Río Papagayo, 300 m, 4 Aug. 1970, *Cruden 1734* (holotype, UC; isotypes, F, GH, K, MEXU, MO).

Radicibus penariis a cormo 3–8 cm, foliis basalibus 6–12 ovatis 8–28 mm latis marginibus integris ad denticulatis, scapis scabris ad 1 m altis, foliis caulibus 2–4, tepalis albis, filamentis linearibus glabris flexus intro super ovarium, antheris connatis.

Storage roots 3–8 cm from corm, 1–2 cm long. Basal leaves 6–12, narrowly ovate to narrowly elliptic, (12–)23–52 cm long, (8–)13–28 mm wide, margins entire to denticulate or serrulate. Scapes scabrous, 33–97 cm high, bearing (0–)1–4(–9) branches. Cauline leaves 2–4, reduced to bracts. Flowers white, nutant, opening in early afternoon. Tepals narrowly elliptic, 6.5–9 mm long to 1 mm wide. Filaments smooth, linear, bent or pinched in above ovary, 2.5–3.3 mm long, insertion basal or nearly so. Anthers connate, 3–5 mm long, the cones strongly tapered. Ovaries 1–2 mm long. Capsules globose, 4–6.5 mm long. In flower July–September. Chromosome number $n = 16$ (*Cruden 1732, 1733, 1734*).

This tetraploid species is known only from Guerrero and adjacent México between 250 and 650 m (Fig. 2). The combination of small flowers, short, strongly tapered anther cones, small capsules, broad basal leaves, and pubescent scapes is unique in subgenus *Mscavea.*

The specific epithet recognizes the town of Atoyac de Alvarez and the Río Atoyac in whose valley I first collected this species.

Paratypes. MEXICO. **Guerrero:** ca. 9.5 km N Atoyac, road to San Vincente and Puerto de Gallo, 300 m, 3 Aug. 1970, *Cruden 1732* (ENCB, K, UC); ca. 6 km N Atoyac, 260 m, 3 Aug. 1970, *Cruden 1733* (MEXU, MO, NY, UC, US, WIS); Dist. Galeana, Atoyac, 25–300 m, 10 Aug. 1939, *Hinton et al. 14526* (ARIZ, GH, LL (2), MO, NY, US); 23 km N Ruta 200 (coast road) on road to Ciudad Altamirano, 500 m, 26 Sep. 1983, *Anderson 12816* (MICH). **México:** Palmar, Dist. Temascaltepec, [650 m], 21 July 1934, *Hinton et al. 6321* (GH, K, NY, US).

10. Echeandia elegans Cruden, sp. nov. TYPE: Mexico. Guerrero: oak woodland, with *Cosmos, Sessilanthera, Commelina, Calochortus, Agave,* ca. 15 km SW Xochipala, road to Puerto de Gallo, 1950 m, 21 Sep. 1973, *Cruden 2096* (holotype, UC; isotypes, ENCB, F, GH, K, MEXU, MO, NY, US).

Radicibus penariis a cormo 2–6 cm, foliis basalibus 5–8 anguste linearibus ad anguste obovatis 7–18 mm latis

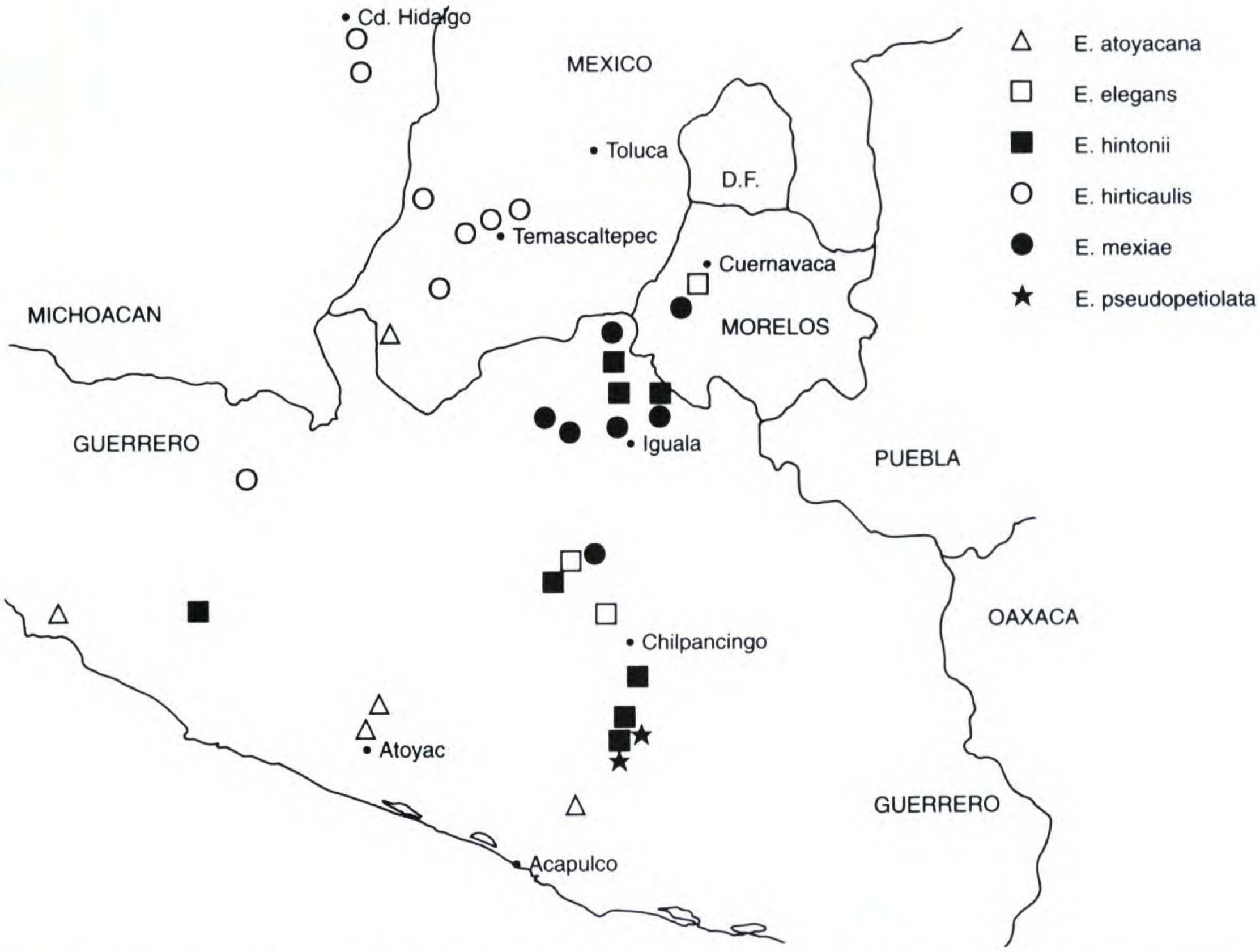

Figure 2. Distributional ranges of six new species in subgenus *Mscavea*. The names of the states are capitalized and towns and cities are indicated by a small solid circle. The distributional range of *Echeandia nayaritensis* is not illustrated.

marginibus intergris ad breviciliatis, scapis glabris glaucis, foliis caulibus 4–10, tepalis albis 13–20 mm longis, filamentis clavatis squamosis, antheris connatis 8–11.5 mm longis.

Storage roots 2–6 cm from corm, 1.5–2.5 cm long. Basal leaves 5–8, narrowly linear to narrowly obovate, 20–70 cm long, 7–14(–18) mm wide, margins entire to short ciliate. Scape glabrous, glaucous, 0.7–1.5 m high, bearing 0–9 branches. Cauline leaves 4–10, lowest 9–30 cm long, others reduced upward. Flowers white, nutant, opening in late morning. Tepals narrowly elliptic, 13–20 mm long, inner 3.5–5 mm wide, outer 1.5–3 mm wide. Filaments scaled, clavate, 3.5–7.5 mm long, insertion dorsal in a pocket. Anthers connate, 8–11.5 mm long, 1.5–2 times the length of the filaments, the cones usually strongly tapered, rarely weakly so. Ovaries 2.5–4 mm long. Capsules broadly oblong, 8–9.5 mm long, 5–5.5 mm wide. In flower September–October. Chromosome number $n = 8$ (*Cruden 2096, 2173*).

This is a species of oak woodlands between 1900 and 2300 m in Guerrero and adjacent Morelos (Fig. 2). The available material includes two types. The specimens from Temisco have 5–9 branches, anther cones that are weakly tapered, and may have large storage roots. The material from central Guerrero has 0–3 branches, strongly tapered anther cones, and quite slender storage roots. Vegetatively, this species is difficult to distinguish from *E. hintonii*. Relative to the latter species, *E. elegans* has longer tepals and anthers, an anther cone that is usually twice the length of the filaments, and smooth lower leaf surfaces.

Paratypes. MEXICO. **Guerrero:** 14 mi. from Mex 95 on road to Chichihualco, 26 Oct. 1970, *Graham 1226* (MICH). **Morelos:** Ruta 95 (libre) in Temisco, ca. 9 km S Cuernavaca, 22 Sep. 1974, *Cruden 2173* (GH, K, MEXU, MICH, UC).

11. Echeandia hintonii Cruden, sp. nov. TYPE: Mexico. Guerrero: on steep, damp bank with *Blechnum, Adiantum, Oxalis, Cuphea,* in pine-oak woods, Ruta 95, near Agua de Obispo, ca. 39 km S Chilpancingo, 780 m, 2 Aug. 1970, *Cruden 1729* (holotype, UC; isotypes, ENCB, F, GH, K, MEXU, MO, NY, US, WIS).

Radicibus penariis a cormo 4–8 cm, foliis basalibus 3–5(–8) anguste linearibus ad anguste obovatis 5–20 mm latis, scapis glabris vel scabris, foliis caulibus 1–4(–5), tepalis albis 10–13 mm longis, filamentis clavatis squamosis, antheris connatis 4.5–8 mm longis, conis antherarum ad apicem valde contractis.

Storage roots 4–8 cm from corm, 1–2 cm long. Basal leaves 3–5(–8), narrowly linear to narrowly obovate, in many minutely papillate between the veins on lower surface, 13–56 cm long, 5–20 mm wide, margin entire to denticulate. Scapes glabrous or scabrescent, 37–111 cm high, bearing 0–4 branches. Cauline leaves 1–4(–5), the lower 8.5–28 cm long. Flowers white, nutant, opening in late morning. Tepals narrowly elliptic, 10–13 mm long, inner 3.5–4.5 mm wide, outer 1.5–2 mm wide. Filaments scaled, clavate, sometimes narrowly so, 3.5–5 mm long, insertion basal or dorsal in a pocket. Anthers connate, 4.5–8 mm long, the cones strongly tapered, 1–1.7 times the length of the filaments. Ovaries 2–4 mm long. Capsules broadly oblong, 7–9 mm long, 4–5 mm wide. In flower late June–October. Chromosome number $n = 8$ (*Cruden 1723, 1729, 2102*).

Among species in subgenus *Mscavea* with narrow leaves and scaled filaments, this species is distinguished by its slender, well-removed storage roots. All collections are from oak and pine-oak woods in central and north-central Guerrero between 750 and 2350 m (Fig. 2). Specimens with pubescent scapes are a little larger and have fewer cauline leaves and tiny papillae on the lower surfaces of the basal and cauline leaves. There is no geographic pattern to plants with glabrous and pubescent scapes, and in the vicinity of Agua de Obispo the leaves of specimens with both types of scapes were papillate; thus, there is little reason to recognize the variation formally.

This species honors George B. Hinton whose collections from Guerrero have added considerably to our understanding of the region's *Echeandia*.

Paratypes. MEXICO. **Guerrero:** Pasión, Dist. Montes de Oca, 1000 m, 5 Oct. 1937, *Hinton et al. 10763* (GH, LL, NY, US); Ruta 95, ca. 17 km S Chilpancingo, ca. 1250 m, 2 Aug. 1970, *Cruden 1723* (ENCB, GH, K, UC); 61 mi. NE Acapulco, Aug. 1965, *Irving 230* (TEX); ca. 29 km SW of Xochipala, on road to Puerto de Gallo, 2225 m, 22 Sep. 1973, *Cruden 2102* (MEXU, UC); 65.3 km from the "desviación" of the Acapulco–México highway, 2350 m, 21 Oct. 1986, *Romo 321* (MEXU); Agua de Obispo, 1100 m, 10 Oct. 1986, *Palomino, Romo & Kenton 308* (MEXU); Taxco, 12 July 1932, *Abbott 239* (GH), 23 July 1936, *Abbott 160* (GH); N Taxco, 25 June 1935, *Clark 7238* (NY).

12. Echeandia hirticaulis Cruden, sp. nov. TYPE: Mexico. México: Ruta 130, ca. 2.5 km NE Temascaltepec, oak woods with *Tigridia, Sphenostigma, Cuphea, Eryngium*, 1750 m, 11 Sep. 1971, *Cruden 1967* (holotype, UC; isotypes, ENCB, GH, K, MEXU, MO).

Radicibus penariis a cormo 2–4 cm, foliis basalibus anguste ovatis (8–)15–42 mm latis marginibus longiciliatis, scapis plerumque hirsutis in dimidio inferiore, foliis caulibus 3–4, tepalis albis, filamentis squamosis, antheris connatis.

Storage roots 2–4 cm from corm, 1–2 cm long. Basal leaves 4–8, narrowly ovate, (17–)25–55 cm long, (8–)15–42 mm wide, margins long ciliate and usually undulate. Scapes usually hirsute on the lower half, hairs long and flat, 0.2–0.5 mm long, rarely with just a few hairs above the lowest cauline leaf, 0.6–1.3 m high, (3–)5–9-branched, which in large individuals bear secondary branches. Cauline leaves 3–4, lowest 12–54 cm long, others reduced to bracts, long ciliate. Flowers white, nutant, opening in late morning. Tepals narrowly elliptic, 12–17 mm long, 1–2 mm wide. Filaments scaled, clavate, (3–)3.5–5.5 mm long, insertion dorsal in a pocket. Anthers connate, (6–)7.5–10.5 mm long, the cones strongly tapered, usually twice the length of the filaments. Ovaries 1–3 mm long. Capsules broadly oblong, 6–8 mm long, 4–5 mm wide. In flower August–mid October. Chromosome number $n = 8$ (*Cruden 1967, 1970*).

This species is found between 1000 and 2000 m in openings in oak and pine-oak woods in a small region in western México, eastern Michoacán, and northern Guerrero (Fig. 2). The closest relative of this species may be *E. macrophylla* Rose, which is found between 1000 and 1500 m in San Luis Potosí and Tamaulipas. Other robust species in the Sierra Volcánica Transversal have straight, smooth filaments, numerous cauline leaves, and/or flowers that open in the afternoon. The specific epithet describes the hirsute scapes.

Paratypes. MEXICO. **Guerrero:** Manchón, Dist. Mina, 27 Sep. 1936, *Hinton et al. 9596* (GH, K, LL, NY, US). **México:** between Zitácuaro and Las Anonas, Dist. Zitácuaro, 1600 m, 23 Aug. 1938, *Hinton et al. 13146* (GH, K, LL, NY, US); Ixtapan, Dist. Temascaltepec, 1000 m, 5 Aug. 1932, *Hinton 1263* (GH, K, MICH, NY, UC, US); Carboneras, Dist. Temascaltepec, 2030 m, 27 Sep. 1932, *Hinton 1852* (K); 4.5 mi. NE Temascaltepec, 1850 m, 11 Oct. 1966, *Anderson & Laskowski 3934* (ENCB, MICH); 5 km S Temascaltepec, 1900 m, 3 Sep. 1965, *Roe, Roe, Mori & Rzedowski 1707* (WIS); road to Tingambato, E San Nicholás, 1600 m, 20 Sep. 1974, *Cruden 2169* (UC). **Michoacán:** 7 mi. E Hidalgo, 20 Aug. 1953, *Manning & Manning 531089* (GH); Ruta 15, near Km 116,

ca. 9.5 km S Tuxpan, 2000 m, 11 Sep. 1971, *Cruden 1970* (ENCB, GH, K, UC).

13. Echeandia mexiae Cruden, sp. nov. TYPE: Mexico. Guerrero: tropical deciduous with palmetto palm, *Salvia*, *Dahlia*, *Bursera*, 4.5 km SW Xochipala, 1280 m, 21 Sep. 1973, *Cruden 2094* (holotype, UC, isotypes, F, GH, K, MEXU, MO, US).

Radicibus penariis a cormo 3–9 cm, foliis basalibus 3–5 anguste obovatis (10–)15–40 mm latis marginibus breviciliatis, scapis scabris 1–1.3 m altis, foliis caulibus 6–15, tepalis albis, filamentis linearibus glabris, antheris connatis.

Storage roots enlarged 3–9 cm from the corm, 1.5–3 cm long. Basal leaves 3–5, narrowly obovate, 37–45 cm long, (10–)15–40 mm wide, margin short ciliate. Scape scabrous throughout, 1–1.3 m high, (3–)5–14-branched, some nodes with two branches and some branches bearing a secondary branch. Cauline leaves 6–15, reduced to bracts. Flowers white, nutant, opening in late afternoon. Tepals narrowly elliptic, 9–13 mm long, inner 2–3 mm wide, outer 1–2 mm wide. Filaments smooth, linear, 2–3.5 mm long, insertion basal or nearly so. Anthers connate, 4.5–6.5 mm long, the cones strongly tapered. Ovaries 1.7–2.5 mm long. Capsules broadly oblong, 5–8 mm long, 4–5 mm wide. In flower August–October. Chromosome number $n = 8$ (*Cruden 2086, 2087, 2088, 2094, 2172*).

All collections of this species were made in north-central Guerrero and adjacent Morelos (Fig. 2) between 400 and 1500 m in relatively dry habitats, including deciduous thorn scrub. Several collections are from limestone-derived soils. The numerous cauline leaves and smooth filaments suggest a relationship with the widespread *E. ramosissima* (Presl) Cruden of western Mexico. Scapes of the latter are usually glabrous, rarely scabrescent near the base, and the basal leaves are usually narrower.

The specific epithet honors Ynes Mexia, who collected extensively in Mexico and South America in the 1920s and 1930s.

Paratypes. MEXICO. **Guerrero:** Cañon de la Mano Negra, near Iguala, 11 Aug. 1905, *Rose, Painter & Rose 9328 (US)*; Ruta 95D, Km 63–64, ca. 12 km S Morelos state line, 1070 m, 20 Sep. 1973, *Cruden 2086* (ENCB, GH, K, TEX, UC, WIS); Ruta 51, ca. 22 km W Iguala, 915 m, 20 Sep. 1973, *Cruden 2087* (ENCB, F, GH, K, UC); ca. 35 km W Iguala, 1500 m, 21 Sep. 1973, *Cruden 2088* (UC); ca. 36 km W of Iguala, 1000 m, 30 Sep. 1982, *Iltis, Benz & Burd 28634* (IA, WIS); Ruta 55, Km 118–119, ca. 30 km N Taxco, 1150 m, 21 Sep. 1974, *Cruden 2172* (MEXU, MO, NY, UC); Temisco, top of barranca Limo, 380–400 m, 30 Oct. 1937, *Mexia 8711* (ARIZ, F, GH, K, MO, NY, U, UC, US). **Morelos:** vicinity of Cuernavaca, 1905, *Lemmon & Lemmon s.n.* (UC).

14. Echeandia nayaritensis Cruden, sp. nov. TYPE: Mexico. Nayarit: Mpio. Ruiz, 1–3 km W El Venado, road from Ruiz to Jesús María, 60 m, 9 Aug. 1980, *Breedlove & Almeda 45284* (holotype, CAS).

Radicibus penariis a cormo 0.5–2 cm, foliis basalibus anguste linearibus, scapis glabris, tepalis albis 12–19 mm longis, filamentis fusiformis squamosis, antheris connatis 6–11 mm longis, conis antherarum filamentis duplo longioribus.

Storage roots enlarged 0.5–2 cm from corm, 1–4 cm long. Basal leaves 3–10, narrowly linear, 16–38 cm long, (2–)4–8 mm wide, entire, sometimes falcate. Scapes glabrous, 41–58 cm high, bearing 0–3 branches. Cauline leaves 1–2, bract-like. Flowers white, nutant. Tepals narrowly elliptic, 12–19 mm long, inner 2–3 mm wide, outer 1–2 mm wide. Filaments scaled, fusiform, 3.0–4.5 mm long, insertion basal or nearly so. Anthers connate, (6–)7.5–11 mm long, the cones weakly tapered, widest in the middle or parallel-sided in lower half, twice the length of the filaments. Ovaries 1–2 mm long. Capsules broadly oblong, 5–7 mm long, 4.5–5.5 mm wide. In flower July–August.

This little-collected species is endemic to the coastal lowlands of northern Nayarit and adjacent Sinaloa, where it occurs in open areas and palm savanna below 400 m. The long tepals, long anthers, and storage roots enlarged and clustered close to the corm suggest a relationship with *E. mcvaughii* Cruden, which occurs at higher elevations in Nayarit, Jalisco, and western Michoacán. The scape of the latter species is usually pubescent, and the basal leaves are usually more than 10 mm wide and falcate.

Paratypes. MEXICO. **Nayarit:** 26.8 mi. S of Sinaloa state line, 200 ft., 24 July 1975, *Dunn, LeDoux & Wallace 21850* (LL). **Sinaloa:** La Jarretadera, ca. 149 km N Tepic, 19 Aug. 1988, *Walker s.n.* (K, MEXU, MO, UC).

15. Echeandia pseudopetiolata Cruden, sp. nov. TYPE: Mexico. Guerrero: Ruta 95, Km 44–45, near El Rincón, ca. 44.5 km S Chilpancingo, 600 m, 2 Aug. 1970, *Cruden 1731* (holotype, UC).

Radicibus penariis a cormo 1–3.5 cm, foliis basalibus 4–6, 43–56 cm longis dimidio inferiore anguste linearis 3–5 mm latis dimidio superiore magnopere expansis ovatis ad ellipticis (21–)26–35(–45) mm latis, scapis glabris, foliis caulibus 2–4, tepalis albis, filamentis linearibus paucisquamosis, antheris connatis.

Storage roots 1–3.5 cm from corm, 1–1.5 cm long. Basal leaves 4–6, oblanceolate, 43–56 cm long, lower half narrowly linear, 3–5 mm wide, expanded in the upper half into a broad, ovate to elliptical blade, (21–)26–35(–45) mm wide, margins short ciliate to ciliate. Scape glabrous, 88–106 cm high, up to 7 branches. Cauline leaves 2–4, the lowest 12.5–36 cm long, resembling the basal leaves, but without the "petiole." Flowers white, nutant, opening in the afternoon. Tepals narrowly elliptic, 6–9 mm long, 1–1.5 mm wide. Filaments weakly scaled, linear, sometimes wrinkled and/or twisted, 3–4 mm long, insertion dorsal in a pocket. Anthers connate, 4–5.5 mm long, the cones strongly tapered. Ovaries 1–2 mm long. Capsules not seen. In flower late July–August. Chromosome number $n = 8$ (*Cruden 1731*).

This species is known from a few collections in south-central Guerrero between 600 and 1100 m along the highway from Acapulco to Iguala (Fig. 2). It occurs in pine-oak and oak woods, as well as disturbed roadsides. The specific epithet describes the distinctive pseudopetiolate basal leaves.

Paratypes. MEXICO. **Guerrero:** Agua de Obispo, 1100 m, 12 Aug. 1962, *Kruse 796* (ENCB); 1000 m, 8 Aug. 1972, *Boege 2441* (MEXU); Hwy. to Acapulco, Km 338, 3 km beyond Acahuizotla, 3000 ft., 20 Aug. 1948, *Moore & Wood 4675* (F, GH, MICH, UC, US).

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